Buyer rebellion forces change onto ATE vendors
PAGE 107

Tough times slash plant construction 40%
PAGE 95

Nokia's merger strategy is unorthodox, but it works!
PAGE 71

A CAHNERS PUBLICATION

# Electronic Business®

FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES WORLDWIDE

NOVEMBER 18,1991

## AMD is COMEBACK COMPANY OF THE YEAR

Ever-defiant Jerry Sanders, founder and CEO of AMD, spent capital lavishly to remake his company
PAGE 40

# Electronic Business

VOLUME 17, NUMBER 22 — FOR THE MANAGEMENT TEAM IN ELECTRONICS, COMPUTER, AND SYSTEMS COMPANIES-WORLDWIDE — NOVEMBER 18, 1991

PAGE 40
W. J. "Jerry" Sanders III, founder, chairman, and CEO of Advanced Micro Devices

Cover photo by Christopher Springmann

## COVER STORY


**40 Make no mistake: AMD is back!**

Advanced Micro Devices Inc. lost nearly $150 million over the past five years, but flamboyant CEO Jerry Sanders guided the company to become a leader in CMOS process technology and microprocessors

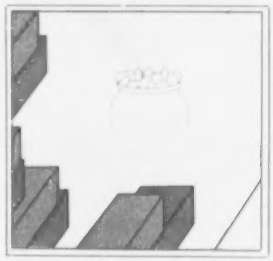
**54 Etec didn't book a single order between 1988 and 1990**

Thanks to a buy-out by the management team and the support of key customers, the sole U.S. maker of direct write e-beam gear returned from oblivion


## UPFRONT

### Business Trends


**11** Harsh reality forecast for chip makers; Contract designers profit from the recession; How to win the time-to-market race; Big isn't better for quality


PAGE 11 SIA remains bullish despite other's pessimism


### Companies to watch


**31** Phylon Inc. updates communication chipsets; Meridian Semiconductor Inc. clones the 386 and 486 microprocessors; Eteq Microsystems Inc. focuses on high-end chips


### Business Barometer


**35 Distributors**
A temporary stumble for the recovery

**36 Communication equipment**
Rebound expected in early 1992 after a bad summer


## FEATURES

### International


**71 Brainstorming in the sauna: inside a Nokia merger**
Nokia and Technophone combined wildly different R&D philosophies, styles, and cultures to build a new cellular-telephone powerhouse


### Economics


**83 What will the patent wars cost your company?**
Cash-strapped patent holders like Texas Instruments are quick to sue to pick up a buck


### Directory


**95 Plant site construction gets the deadbolt**
During the first six months of 1991, sluggish business conditions have slashed U.S. industrial construction and building by 40%, but there's still plenty of cheap space available


### Markets


**107 ATE plans for a brighter future— again**
After a year of slow growth, ATE vendors must crank out lower-cost products to inject new life into their $3 billion market


## DEPARTMENTS

### Inside Business


**7** Of comebacks and commitment


### My View


**119** A different kind of selling. A bitter pill to swallow


### Company Index


**122** Companies covered in this issue


### Advertiser Index


**123** Advertisers covered in this issue


### Viewpoint


**124** Nice going Jerry. Now don't blow it!

## EDITORIAL STAFF

**Publisher:** Frank J. Burge

**Editor:** John Russell

**Managing Editors:** H. Garrett DeYoung, Hugh G. Willett

**Senior Editors:** Linda Stallmann (Financial), Rick Whiting, Barbara N. Berkman, Teri Sprackland, Elizabeth B. Baatz, Peter L. Burrows

**Associate Editor:** David Webb

**Assistant Editor:** Barbara Jorgensen

**Copy Editor:** Elaine M. Cummings

**Contributing Editors:** Dwight B. Davis (Seattle), Madeline Franchi (Cahners Economics), Sarah Glazer (Boston), Julie Handelman (Cahners Economics), Nancy Rutter (San Francisco), Paula Doe (Seattle), John Farrell (Cahners Economics), Tom McHale, Joel McCormick, Russ Arensman (Hong Kong), Xiong Xiaoge, John Parker

**Correspondents:** Charles Cohen (Tokyo), Geoff Crane (Seoul), Chris Brown (Taipei), Ken Stier (Bangkok), Craig Addison (Sydney)

**Consulting Editors:** Alberto Socolovsky, Lewis H. Young

**Senior Production Editor:** Karen J. Covey

**Assistant Production Editor:** Maura A. Baker

**Editorial Assistant:** Jean O'Brien

## ART STAFF

**Art Director:** Michael Roach

**Associate Art Director:** Elizabeth Zisa

**Staff Artist:** Michele G. Kane

## EDITORIAL OFFICES

**Boston:** Cahners Building
275 Washington Street, Newton, MA 02158
(617) 964-3030 Telex: 94 0573 CPC BSN
Fax: (617) 558-4327 MCI: EBBOS

**San Jose, Calif.:** Hugh G. Willett, Teri Sprackland, David Webb
Sherman Building, 3031 Tisch Way, Suite 100,
San Jose, CA 95128 (408) 243-8838
Fax: (408) 243-2144

**Northwest:** Dwight B. Davis
11020 86th Ave. NE
Kirkland, WA 98034 (206) 820-5741

**London:** Barbara N. Berkman
27 Paul Street
London EC2A4JU England 011-44-71-628-7030
Fax: 011-44-71-628-5984

## PRODUCTION

**VP Production:** Wayne Hulitzky

**Director of Production/Manufacturing:** John R. Sanders

**Production Supervisor:** Andrew A. Jantz

**Production Assistant:** Victoria T. Moore

## CIRCULATION

**Circulation Manager:** Ann Ward
44 Cook Street, Denver, CO 80206
(303) 388-4511

**Total Circulation:** 77,804

## REPRINTS

ELECTRONIC BUSINESS articles are available on a custom printing basis at reasonable prices. Contact Andrea Marwitz, Cahners Reprint Service, Cahners Plaza, 1350 E. Touhy Ave., P.O. Box 5080, Des Plaines, IL 60018 (708) 635-8800
Electronic Business can be purchased on 35mm microfilm through University Microfilm Int. Periodical Entry Dept., 300 Zeeb Road, Ann Arbor, MI 48106


## INSIDE BUSINESS

# Of comebacks and commitment

IN HIS new book, *Commitment*, Harvard Business School professor Pankaj Ghemawat creates a new model of business strategy. Forget about "success factors" and probability analysis, he writes. A company stands out in its industry because of a commitment to a particular market, technology, or sales strategy.

**Senior editor Sprackland (l.), AMD's Sanders (c.), and managing editor Willett focus on commitment**

Ghemawat cites Wal-Mart, Honda, and Lockheed, but he could just as well have been writing about Advanced Micro Devices and its colorful CEO, W. J. Sanders, the subject of our cover story. Sanders's commitment to submicron technology, reports senior editor Teri Sprackland, has withstood the strain of a $200 million-plus R&D budget and legal battles with Intel for the right to market 386 chips. Today, with sales of those chips booming and profits replacing losses, Sanders's choice seems to have been justified.

Semiconductor equipment producer Etec, meanwhile, is committed to another important idea: the power of partnerships. Cherished traditions of independence have made it a tough sell in America, but that's getting easier as U.S. chip makers continue to take it on the chin from foreign conglomerates. The only U.S. player in its market in 1989, Etec had little to lose by trying a new approach, reports West Coast managing editor Hugh Willett. Sales were all but nonexistent, as was employee morale. Etec managers negotiated a complex buyout deal that combined their technical expertise with equity investment from several industry leaders. Result: a $70 million climb in sales and a chance to keep important technology alive and well—at home.

AMD and Etec clearly illustrate that "commitment" is more than a buzzword. It's the indispensible starting point for any company out to capture the title "Comeback Company of the Year." □


ELECTRONIC BUSINESS® (ISSN 0163-6197, GST Reg. #123397457) is published twice a month, except monthly in December, by The Cahners Publishing Company, A Division of Reed Publishing USA, 275 Washington Street, Newton, MA 02158-1630. Terrence M. McDermott, President/Chief Operating Officer; Frank Sibley, Executive Vice President; Jerry D. Neth, Senior Vice President/Publishing Operations; J.J. Walsh, Senior Vice President/Finance; Thomas J. Dellamaria, Senior Vice President/Production and Manufacturing; Ralph Knupp, Vice President/Human Resources. ELECTRONIC BUSINESS® is a registered trademark of Reed Properties Inc., used under license. Circulation records are maintained at Cahners Publishing Company, 44 Cook Street, Denver, CO 80206-5800. Telephone: (303)388-4511. Second-class postage paid at Denver, CO 80206-5800 and additional mailing offices. **POSTMASTER: Send address corrections to ELECTRONIC BUSINESS®, PO Box 173377, Denver, CO 80217-3377.** ELECTRONIC BUSINESS® copyright 1991 by Reed Publishing USA. Robert L. Krakoff, President and Chief Executive Officer. Annual subscription rates for non-qualified people: USA, $84.95; Mexico, $124.95; Canada, $133.70; other countries, $149.95 per year; $140, air mail surcharge. Subscriptions include all issues. Except for special issues where price changes are indicated, single copies are available for $15.00 (USA, Canada/Mexico and foreign). Please address all subscription mail to Eric Schmierer, 44 Cook Street, Denver, CO 80206-5800. Cahners Publishing Company, A Division of Reed Publishing USA • Specialized Business Magazines for Building & Construction • Research • Technology • Electronics • Computing • Printing • Publishing • Health Care • Foodservice • Packaging • Environmental Engineering • Manufacturing • Entertainment • Media • Home Furnishings • Interior Design • Lodging. Specialized Consumer Magazines for Child Care • Boating • Wedding Planning.

BPA ABP

SEMICONDUCTORS

# Chip market reality sets in

HIGH DOUBLE-DIGIT growth rates in the semiconductor industry, once considered its birthright, are likely to be a thing of the past. Chip makers are going to have to adapt their business plans to allow for profitability with growth rates of about 10%, industry watchers say.

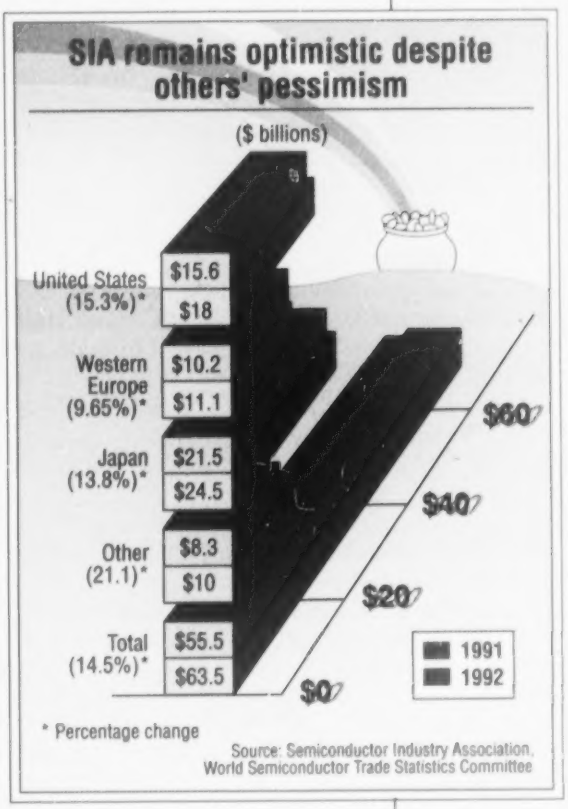
Although both the Semiconductor Industry Association (SIA) and Dataquest recently forecast chip sales growth in the low teens for 1992, many observers think the chip business won't make those numbers. An unexpectedly poor third quarter has shaken confidence in an industry upturn soon. "Our sales dropped so precipitously in July that we wondered whether our phone lines were working," quipped one industry participant.

"A lot of industries would be very happy to see 10% growth, but in the chip industry, that's considered a recession," says Dean McCarron, VP of market research firm In-Stat. "Companies are going to have to adjust to a new set of realities as the industry matures."

That means forging new business relationships, targeting new products, and aggressively seeking overseas growth markets. Partnering among chip companies will allow them to share risk and reduce overhead. Chip makers will also be forced to pay more attention to the needs of their customer's customers—the end-users.

Many of the trends aren't new, they're just accelerating. Geographically, for example, growth rates remain stronger in Asia than in the other areas of the world. MOS microcomponents continue to grow faster than bipolar products, according to Dataquest, and BiCMOS, although important and growing, is still dwarfed by CMOS demand.

Here's a quick market outlook. Demand for microcontrollers used in consumer and telecom products in Europe and Japan is strong, while MPUs suffer from soft PC demand. The memory business remains in turmoil as DRAM prices erode, as bit consumption growth remains lackluster, and as fast static RAMs become a commodity.




Adjusting to the current sluggish demand and the emerging slow-growth reality isn't easy for chip makers. The industry is maturing.

- It's much harder to move a $50-plus billion industry up a steep growth curve, notes Larry Hollatz, assistant vice president for technology of NCR Corp.'s Microelectronic Products Division;
- Jerry Sanders, CEO of Advanced Micro Devices, says it's time to stop assuming the industry can grow its way out of problems.

Dataquest forecasts the 1992 semiconductor sales rate at 13.5%. That's not much different from the 13.7% growth forecast it originally made for 1991 worldwide semiconductor sales, which it has since reduced to 9.3%. Dataquest blames unanticipated currency fluctuations for the revision. The SIA predicts total semiconductor sales worldwide to grow 9.8% this year, to nearly $55.5 billion, and then 14.5% in 1992, to nearly $63.5 billion, as the economy moves into recovery. In-Stat is more pessimistic—some would say realistic. It was first to forecast 1991's disappointing performance, and In-Stat anticipates no end to the current recession. In fact, it predicts growth rates around 10% for the worldwide chip industry in 1992.

*—By Teri Sprackland in San Jose*

SEMICONDUCTOR EQUIPMENT

## Small U.S. companies rate high on customer service

DESPITE NUMEROUS reports to the contrary, the small U.S. semiconductor equipment manufacturer isn't dead yet. In fact, its demise may be greatly exaggerated. Service is now the number-one criterion among equipment buyers, and small U.S. companies are turning terrific service into a competitive weapon. At least that's the gist of VLSI Research Inc.'s annual equipment customer satisfaction survey.

Complaints about the service from bigger IC equipment vendors—most

## 1990's top 10 customer-rated IC equipment companies

| Company country | Sales* ($ millions) |
|---|---|
| 1. **Advantest** Japan | $423 |
| 2. **ASECO** U.S. | 12 |
| 3. **ESEC** Swiss | 30 |
| 4. **Hewlett-Packard** U.S. | 90 |
| 5. **Novellus** U.S. | 67 |
| 6. **Lam Research** U.S. | 135 |
| 7. **Teradyne** U.S. | 218 |
| 8. **LTX** U.S. | 166 |
| 9. **KLA Instruments** U.S. | 153 |
| 10. **Eaton** U.S. | 141 |

*Semiconductor equipment sales only

Source: VLSI Research Inc.

of which are Japanese—were plentiful, while smaller companies drew praise. Smaller U.S. companies are trying harder to meet customer service expectations and to compete against larger organizations' financial muscle, says VLSI president Dan Hutcheson.

Three U.S. companies were the only newcomers to the 10 top-rated equipment manufacturers, Hutcheson notes. The trio include Hewlett-Packard, Eaton, and Novellus. The latter two, with revenue of $141 million and $67 million, respectively, can be counted as small. Eaton, said one respondent, "is genuinely concerned with meeting our needs and helping us achieve our current and future goals." Eaton's rating in process support went up 22.41% from 1989 to 1990; Novellus's rose 20%.

It should be noted that 1990's top-rated equipment vendor, Advantest, is Japanese; but with annual revenue of $423 million, it is two or three times larger than the other nine.

For many large equipment vendors, being remote from their customers has hurt their service rating. One reason: As Japanese companies grow into large international concerns, they no longer release their first-generation products in Japan only and then iron out problems before shipping new products to the United States. As a result, customers may receive imperfect new equipment, and they say the long service pipeline to Japan is an obstacle to solving problems.

Don't get giddy over this news. There's still a distinction between service/support and reliability. Improvements in equipment have virtually eliminated uptime as customers' main concern. Big companies often do well on reliability. "The big battlefront now is service: How do your front-line people handle customer comment and contact," says Hutcheson. "End users are vehement in their gripes about poor service, coupled with a substantial number of gripes about 'arrogance' on the part of suppliers," he says. Wafer process companies, in particular, have some irate customers, according to the survey.

*—By Teri Sprackland in San Jose*

EXPORTS

## Foreign-owned electronics: Why aren't you exporting?

WHILE U.S. electronics companies are scrambling like crazy to export, the U.S.-based subsidiaries of foreign-owned electronic companies are not. That is different from patterns in other industries where the drive to make a buck has also prompted aggressive exporting across the board. U.S.-based production by these foreign-owned companies has also *not* displaced imports to the U.S. by their parents.

The chemical and auto industries are benefiting from the foreign buying binge of U.S. companies during the 1980s. Production from U.S. affiliates of foreign multinationals has displaced imports from the foreign parent into the United States. Also, the transfer of new technologies and management techniques through the foreign-owned affiliates is forcing domestic-owned companies to be more competitive, resulting in more exports from the United States.

This is not the case for the electronics industry according to a study by economist James Orr of the Federal Reserve Bank of New York. "Despite the [electronics] affiliates' competitiveness in the domestic market over the 1980s, their effect on industry performance and export expansion has not been substantial to date," says Orr. These foreign-owned affiliates haven't been a strong source of new capital spending in the industry, and due to electronics investments in developing countries and outsourcing by U.S. producers, Orr doesn't expect the import boom of electronics products to abate either.

Despite reluctance by U.S.-based foreign-owned subsidiaries to jump into the export market, the contin-

### Foreign affiliates sell more, invest less

- Sales from foreign affiliates in the U.S. accounted for over 13% of all domestic electronics production in 1988, up from 9% in 1980
- These affiliates owned 13% of all electronics industry assets located in the U.S. in 1988, up from 10% in 1980
- Foreign-owned companies' share of total electronics industry capital spending fell over the same time, to around 8% in 1988 from nearly 10% in 1980
- Although the U.S. domestic market for electronic equipment doubled between 1980 and 1988, imports more than tripled over the same period. Sales of the U.S. affiliates of foreign companies grew two and one-half times

Source: James Orr, Federal Reserve Bank of New York

**MARKETS**

**An easing in U.S. export restrictions coupled with economic reform in Eastern Europe is feeding the growing demand for Western technology. The value of licenses for sales of computers, aerospace products, and other high-tech goods rose 78% from 1988 to 1990 in Poland, Hungary, and the U.S.S.R.—a trend that should continue at an even greater rate in the coming years.**

*—By Elizabeth B. Baatz*

ued low U.S. dollar is expected to prompt U.S.-owned manufacturers to push into foreign markets.

*—By Elizabeth B. Baatz*

**COMPETITIVENESS**

## Contract designers make the most of the recession

CONTRACT DESIGN companies tend to profit from others' misfortunes. So as the recession hacked away at most electronics manufacturers, business for design contract houses boomed. Stratos Product Development, for example, grew 58% in the past year to more than $3 million. Nebula Corp. grew from about $500,000 to about $2 million in that same time.

That's typical in a down market when layoffs cull design expertise from many companies. Conversely, contract designers may be worth keeping around even when things get better. Some, such as Ideo Product Development, have expanded services to become more broad-based and experienced. Ideo is the product of a four-company merger that brought together 125 specialists from disciplines as varied as electronic design to manufacturing engineering.

Many customers have been happy with what they've seen. "Stratos did an excellent job of blending elegance and functionality into our electrostatic plotter," says John Higginson, an engineering VP with Raster Graphics.

Why the success? Because contract designers offer competent engineering without the overhead of full-time employees—or the wasted time. According to a study by Arthur D. Little, engineers spend 35% of their time actually designing new products. "When we finish a project, we just fly away until you need us again," says Stratos CEO Allan Stephan.

Companies looking to contract should look for experience, breadth of expertise, and contractors who cannot be hired away at a moment's notice. In tough times, insiders caution, many a laid-off engineer has a "consultant" sign outside his door. Look for how much repeat business they get to make sure you don't end up with a half-finished, poorly conceived product design.

As for the future, contract designers remain bullish. "It's true we do well in a recession, but it's also true that customers need help in good times to get more products out in shorter market windows," says Jeff Pollak, a Nebula sales engineer. "The only time that is really bad for consultants is when the industry is flat and predictable, and that almost never happens."

*—By Peter Burrows*

**PRODUCT DEVELOPMENT**

## Employee empowerment wins time-to-market race

DON'T UNDERESTIMATE employee empowerment. A group of electronics companies found it was a major factor in slashing time-to-market (TTM) by an average of 58%.

Disciples of product development and quality management have been espousing the empowerment philosophy for years, but a recent study by Rosenau Consulting has turned up some pretty powerful benchmarks.

"Some companies could get products out faster by handing over the process to their employees," says Milton Rosenau, president of Rosenau Consulting. "If you give workers the power to violate rules, they'll come up with some creative methods that work."

Rosenau studied 18 electronics companies, some of which reduced TTM by as much as 75%. Among them was Warner Electric, whose clutch brake got to market in 36 weeks, down from 36 *months*.

Does faster TTM translate into higher profits or superior products? It depends on the market you're in, says a consultant at McKinsey & Co. In a high-growth market such as consumer electronics, shipping a product six months late can drag profits down by as much as 33%. The impact in a slow-growth market with long

**Some reported TTM reductions**

| Company /product | Reduction in cycle time |
|---|---|
| **Honeywell** | |
| thermostats | 75% |
| **IBM** | |
| PCs | 73 |
| **Allen-Bradley** | |
| electrical contactors | 67 |
| **Motorola** | |
| pocket pagers | 63 |
| **Hewlett-Packard** | |
| computer printer | 59 |
| **Intel** | |
| chips | 56 |
| **Codex** | |
| communications products | 54 |
| **NCR** | |
| checkout counter terminals | 50 |
| **3M** | |
| digital color printers | 50 |
| **Whistler** | |
| radar detectors | 48 |

Source: Rosenau Consulting

product life-cycles could be a considerably lower 7% drop in profits. Rapidly changing markets are the ones most likely to benefit from faster production.

*—By Quang Bao*

INTERNATIONAL

## Is scaled software pricing a solution to foreign piracy?

PACIFIC RIM countries, often considered hotbeds of software piracy, have a message for U.S. software companies: If you want to reduce piracy, reduce prices. What may sound like international extortion at first blush has generated U.S. interest.

Delegates of the Southeast Asian Information Technology Organization proposed software prices in individual countries be based on GNP, saying the proportional pricing structure would lower the cost of software applications in developing countries and so reduce the incentive to make or buy illegally copied software.

Long-term gains from reduced software piracy would more than make up for revenue lost by lower prices, says Stan Shih, CEO of Taiwan's Acer Inc. That sounds fishy to many software developers.

Shih says the software pricing scheme was initially proposed by delegates from Malaysia and the Philippines, and Shih has brought the plan to the Washington D.C.-based Software Publishers Association, a crusader against software piracy.

Ken Wasch, the association's executive director, called the proposal "an interesting idea" but is skeptical that software price cuts would reduce software piracy, adding that vendors need to cover local distribution costs in their prices.

*—By Rick Whiting*

QUALITY

## Three companies prove big isn't necessarily better

THE DAY AFTER the Malcolm Baldrige National Quality Award announcements, no big bashes were planned at Solectron.

Winston Chen, chairman and CEO of Solectron said, "People are excited here, but it's just business as usual."

Maybe it was treating quality as a "business as usual" activity that contributed the Baldrige sweep by three relatively small electronics companies. Chen, for one, says he's happiest to report that it doesn't take millions of dollars or mounds of excessive paperwork to win.

Contract manufacturer Solectron with 2,000 employees; power-supply maker Zytec Corp. with 700 employees; and cooling device producer Marlow Industries Inc. with just 150 workers proved you don't have to be big to beat the likes of Intel and Texas Instruments. With 106 companies applying for the award in 1991, it was the first year no large manufacturer won. Intel, furious about not winning, indicates it won't enter the competition next year.

Some Baldrige examiners admitted they were tough judges; negative publicity following Cadillac's Baldrige win last year may have contributed to raising the award's standards.

Zytec is getting help dealing with the flood of publicity from the Commerce Department and IBM, its customer and a 1990 Baldrige winner.

MODULAR PCs

## Who benefits most from modular PC upgradeability?

A RECENT wave of "modular PC" announcements by Dell, Advanced Logic Research, and Compaq tout value to users, but the real modularity advantage may be to vendors. Other manufacturers should take notice.

In theory, modularity allows users to upgrade by simply unplugging one I/O or memory card and plugging in a newer generation—but users aren't exactly beating down vendors' doors. AST Research reports that only 5% of its installed user base actually took advantage of upgradeability in its PCs but it expects that numberto increase.

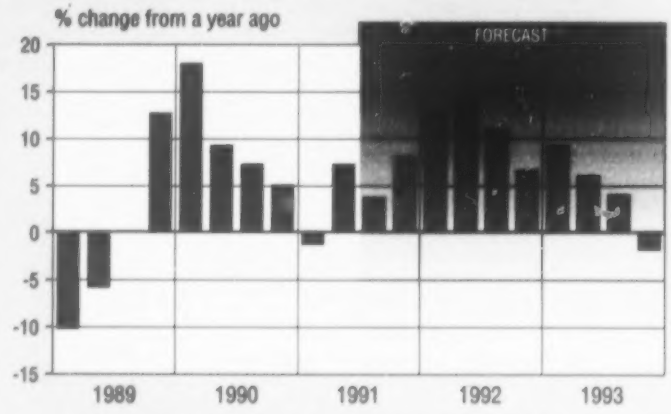
The real savings are to vendors, in cost of design and in inventory. Says International Data analyst Richard Zwetchkenbaum, "Compaq wanted to differentiate through modular design, but it also wanted to cut costs."

Modular standards allow greater design flexibility, and product lines can share modular components across systems, eliminating a good share of product-specific inventories.

The idea isn't new—AST Research, Acer, and IBM have offered PCs with varying degrees of modular upgradeability. Now that gross profit margins are plummeting and product life-cycles are shrinking, however, companies realize modularity offers certain architectural cost benefits that nonmodular architectures don't.

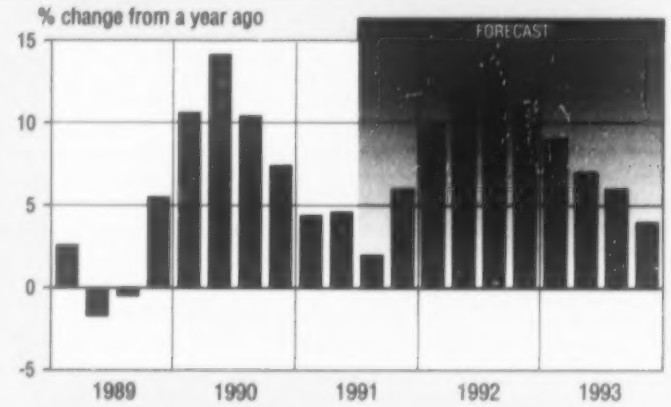
*—By David Webb in San Jose*

## Electronic distributor orders crimped in 1991...



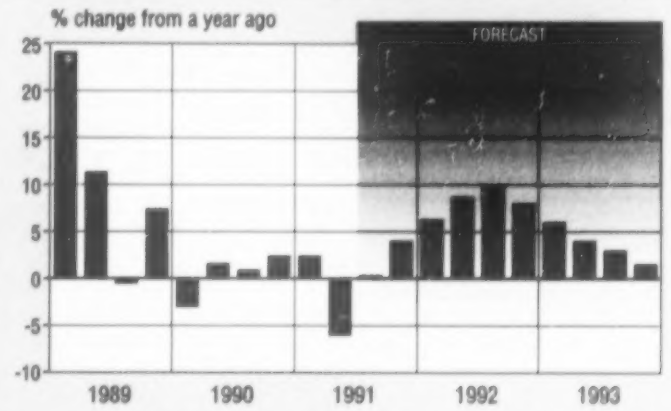

Source: National Electronic Distributors Association; forecast: Cahners Economics

## ...but the shipments recovery isn't far off track...




Source: National Electronic Distributors Association; forecast: Cahners Economics

## ...and semis sold through distribution hang on




Source: Semiconductor Industry Association; forecast: Cahners Economics

# Distributors' recovery stumbles temporarily

THREE MONTHS AGO Cahners Economics reported that the forecast for distribution was looking relatively rosy. Unfortunately, the summer statistics were disappointing. The severity of the summer slowdown was unexpected, but the predicted recovery is only temporarily on hold until next year.

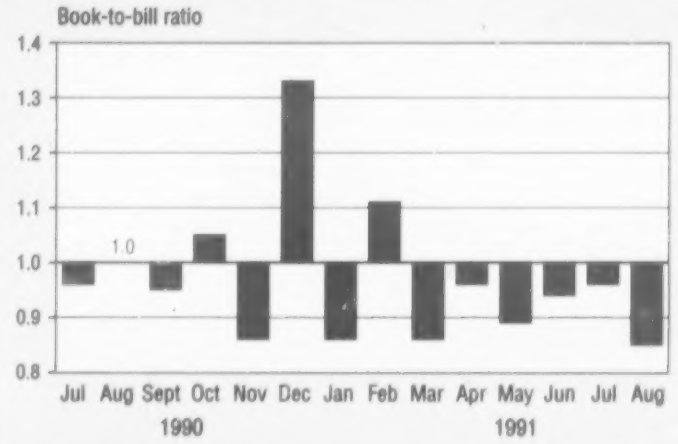
Cahners had predicted new orders would climb 9.6% above year-ago levels in the third quarter of 1991. Now our reading of July and August data from the National Electronic Distributors Association suggests orders rose only about 3.7%. Shipments are estimated to have risen 2% in the third quarter. Statistics from the Semiconductor Industry Association on semiconductor sales made through distributors confirm the sluggish growth trend. These sales fell 3.7% for the three months ending in July. Since distributors tend to be a leading indicator for the rest of the electronics industry, the uneven performance is worrying.

As for the future, we're still sticking by the forecast of stronger gains in the final quarter of this year and the four quarters of 1992. The bottom of the cycle is always the toughest time to call a recovery, but some signs of hope, notably lower interest rates and a robust rate of new product introductions, will help push a modest recovery forward. Also, after two months of a book-to-bill ratio below 1.00, the August ratio anchored in at 1.01, providing a glimpse of better times ahead.

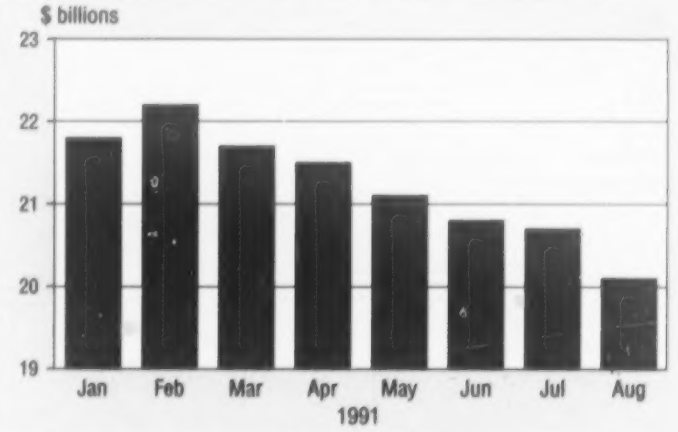
The greatest risk to the forecast, perhaps, is not a double-dip recession. Instead, the risk may be a rebound that is healthier than anyone now has the guts to predict. Cahners Economics forecasts distributor sales will grow 4.3% by the end of 1991, 11.7% in 1992, and 6.5% in 1993.

*—By Julie Handelman*

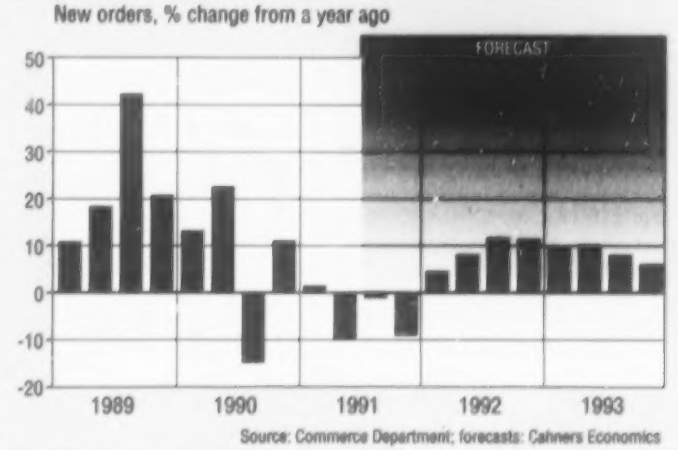
## Communication equipment book-to-bill slumps...




## ...forcing backlogs down drastically in 1991...




## ...but 1992 will bring a mild recovery




Source: Commerce Department; forecasts: Cahners Economics

## Backlogs cushion communication equipment

THE RECESSION ENDED in the second quarter of this year, say 80% of the economists in the National Association of Business Economists. The communication equipment industry, however, still wallowed this past summer in its worst recession since 1986-87. The industry's resuscitation won't begin until the first quarter of 1992.

Volatile as ever, new orders for communication equipment tumbled in August, down 14.4% from July and 12.7% from August 1990. That decline was not an isolated event. New orders dropped below year-ago levels in six of the eight months from January through August.

The industry's book-to-bill ratio hung below the break-even 1.00 mark from March through August. Not in the past two decades has the communication equipment sector experienced such a long six-month stretch of billings outracing bookings. Fortunately, when the 1991 recession hit, U.S. communication equipment factories held backorders totaling about $22 billion—enough to keep shipments at their current level for roughly five and a half months. By August, that buffer had been drawn down by $2 billion, but the remaining stash should keep factories humming through the rest of the winter.

Cahners Economics expects new orders to show losses for the third and fourth quarters of this year relative to 1990, handing the industry its first annual decline in bookings since 1987. By the first quarter of the new year, however, the communication equipment industry will favorably respond to capital spending increases. Industry shipments are forecast to rise 4.3% to $49.2 million in 1991, 6.5% in 1992, and 8.2% in 1993.

*—By Madeline Franchi*

# Etec didn't book a single order between 1988 and 1990

This year the sole U.S. maker of direct write e-beam gear will sell $70 million, thanks to a management buy-out and customer buy-in

By Hugh G. Willett

Seldom has a company had to climb such a steep slope to make a comeback as the recent return to life of Etec Inc., the Hayward, Calif.-based manufacturer of electron-beam equipment for the semiconductor industry. Once a subsidiary of Norwalk, Conn.-based Perkin-Elmer Corp. (PE), Etec went from prosperity in the mid-1980s to virtually zero sales several years later and then to $70 million in revenue in 1991.

"The company didn't book a single order between 1988 and 1990," exclaims Charles Minihan, Etec's chairman and CEO. Minihan was general manager of Etec from 1979 to 1985 and returned from a short-lived retirement to lead the turnaround.

Etec's rebound is the result of a unique partnership involving IBM, Grumman, Zitel, DuPont, Perkin-Elmer, Micron Technology, the Sematech consortium, and a hardy group of about 60 Etec managers. A buy-out by the management team led by Minihan, with the support of key customers, prevented the company from becoming another casualty in the U.S. semiconductor equipment industry.

Etec's roller-coaster history through several business cycles wore out the patience of its corporate parent, which was essentially an analytical instrument vendor. PE executives had become weary of the semiconductor industry's ups and downs, Minihan says. Although 1987 was a peak sales year, Minihan says the "Wall Street worshipers" at PE began to hunt for a buyer for Etec and several other semiconductor divisions in 1988, less than 10 years after acquiring it. Consequently, morale suffered, customers worried, and sales evaporated. "The employees went through a period of disillu-

"We got six companies to agree to cooperate, negotiated with each of them, and then had to get them all to agree again," recalls Etec president Tom Halloran, "but when it was over, they were really committed to working together"

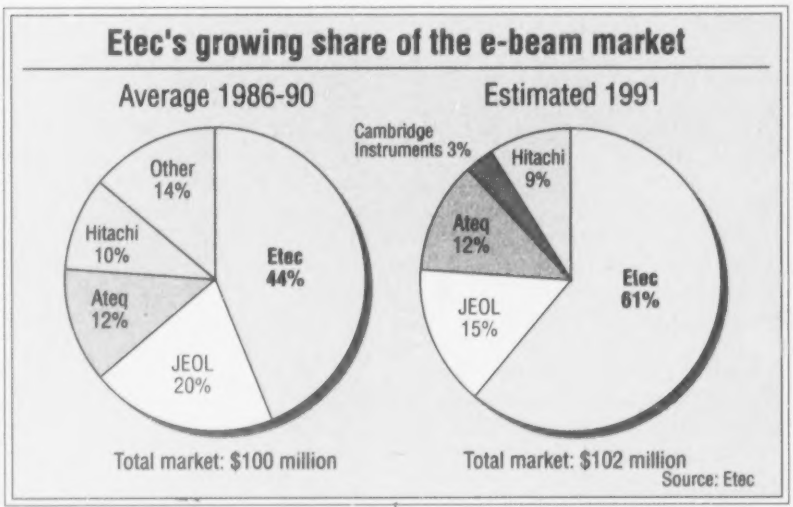
**What a difference a buy-out makes for Etec**

| | ($ millions) 1990 | 1991 | % change |
|---|---|---|---|
| Revenue | $48.5 | $70.0 | 44% |
| Bookings | 30.0 | 80.0 | 266 |

Source: Etec

sionment that really hurt the company," he adds.

The semiconductor industry viewed PE's treatment of Etec with alarm—it was a piece of the complex chip-making puzzle the industry could not afford to lose. Etec is the only U.S. company that makes direct-write electron-beam lithography equipment—it etches circuits directly onto silicon. The technology is considered critical for production of chips at 64-Mbit and higher densities. About a half-dozen manufacturers make direct-write e-beam equipment for commercial or internal use, and most of them are Japanese. The technology also is used to make photo masks, not only for giant companies such as DuPont, but also for small mask shops such as Diamon in Los Gatos, Calif. "Under Perkin-Elmer, Etec wasn't getting the resources to invest in new technology," says Richard Diola, vice president of Diamon.




ALTHOUGH CHIP MAKERS still rely heavily on optical lithography, e-beam technology is important. Etec had delivered more than 130 of the world's 200 installed e-beam systems. Companies such as Diamon that had invested in earlier generations of Etec equipment were worried they would have to go to Japan to find new suppliers. "It was of grave concern to us that this technology stayed in the United States," notes Diola. Adds Peggy Wood, senior industry analyst with Dataquest in San Jose, "It's very important to the industry to have an international balance of that technology."

**Etec grabbed 61% of the worldwide e-beam market within 18 months, up from 44% in the beginning of 1990**

The loss of resident e-beam technology in the U.S. would have dire consequences for the domestic electronics industry. Optical lithography will not have the precision to deliver 256-Mbit DRAMs by the time of their estimated development in 1994, Minihan contends. By the year 2000, e-beam equipment will be making gigabit DRAMs, and optical lithography will be only a memory, he predicts.

Several U.S. companies looked at Etec but declined to make an offer to Perkin-Elmer. The prevailing attitude in the industry was that it would take too much work and too much money to make the company competitive again, despite its historic strengths. Faced with a dearth of suitors, Etec managers decided to court PE themselves.

After almost two years of complex negotiations, the managers had gathered a group of six corporate investors to support their bid of $39 million in cash and securities in March 1990. Grumman, DuPont, and Micron Technology each invested $5 million for an equity stake in the company, Zitel invested $1 million, and managers contributed an undisclosed amount of cash in exchange for a 17% stake. Their investment—a $6 million note guaranteed by IBM and DuPont, preferred stock, and junk bonds—was used to pay Perkin-Elmer. IBM was given an equity interest in exchange for its loan-guarantee and contributing e-beam technology developed internally. The new technology was needed to put Etec's next generation machines in a leadership position and convince current customers that a technology migration path was in place.

Etec president Tom Halloran, who left Etec in 1987 before joining the management group, says his team pulled off one of the most complicated deals in the history of the semiconductor industry: "We got six companies to agree to cooperate, negotiated with each of them, and then had to get them all to agree again." The arduous negotiations, however, led to a stronger venture. "The difficulty of negotiating the deal turned out to be a plus," explains Halloran. "When it was over, they were really committed to working together."

AFTER THE DEAL was completed Halloran and Minihan wasted no time attacking the company's problems. They immediately visited every customer worldwide to restore their confidence. The pedigree of the returning managers had a lot to do with regaining customer confidence, according to Dataquest's Wood. Customers knew that Halloran and Minihan had direct-write equipment experience, had worked together for years, and were respected by the investors. Halloran and Minihan heard first-hand about

Etec's tattered image and what its customers said it would take for Etec to get back into business.

SIX WEEKS AFTER the deal was signed, Etec had a company strategy tuned to the needs of its customers. Within three months, Minihan and Halloran picked a new management team—including some Etec alumni—more attuned to customer service, and they trimmed the 500-employee roster by about 80 employees. Minihan and Halloran paid particular attention to restructuring middle management, which they say had stagnated. "We shook things up a bit, but we were able to get people back in the mood to succeed," Halloran explains.

After making a forceful and, Halloran concedes, expensive effort to resolve outstanding customer complaints, Etec began to take advantage of its worldwide marketing reach—50 employees in Japan, 30 in Europe, and one in Korea. The company that hadn't booked an order in years managed to sell seven systems—at about $3.5 million to $4 million each—by the end of fiscal 1990.

More importantly, according to John Wiesner, senior VP of research and engineering, customer confidence increased since Etec is developing IBM's e-beam technology to provide systems in 1993 capable of 0.2 micron resolution. IBM's technology also brought in revenue in the form of development contracts from the U.S. Department of Defense and Sematech of Austin, Tex.

Fiscal 1991 saw strong sales in Japan and Korea, generating a $60 million backlog of orders, although the slump that hit U.S. chip makers last year has prevented Etec from further enjoying its leverage as the only domestic supplier of e-beam equipment. Etec claims to have won 61% of the worldwide e-beam lithography market within 18 months of its liberation from PE, up from 44% in the beginning of 1990.

Crucial support on the home front came in the form of a $20 million development contract from Sematech.

**A management buy-out, led by Etec CEO Charles Minihan, prevented another casualty in the U.S. semiconductor equipment industry**

The contract provides not only funds for technology development, but also allows Etec to work closely with other suppliers and potential customers to provide a solution that is well integrated both upstream and downstream. "I can't overemphasize how important Sematech has been to our effort," Minihan says.

**Etec's managers did one of the most complicated deals in the semiconductor industry's history**

Partnering with customers and suppliers has become more than a way to raise cash—it has become the central theme to the company's business plan. Earlier this year, Etec formed an alliance with European Silicon Structures to develop equipment using direct-write e-beam technology to speed the production of custom chips. Development alliances have been signed with about a dozen organizations this year, including chip maker Advanced Micro Devices Inc. of Sunnyvale, Calif. Such alliances involve a close working relationship to identify specific challenges, splitting the engineering costs between both parties and developing a solution that fits the customer's needs in a shorter time.

Minihan argues that Etec's partnership strategy is a model for the U.S. electronics industry, which in his eyes is basically a large group of small companies that compete with giant foreign conglomerates—many backed by their governments. The U.S. electronics industry understands technology as well as any other country, he says, but it doesn't have the financing ability to overcome the high cost of capital without some sort of team effort. "U.S. chip makers just can't afford to devote 10% to 15% of their sales dollars to research," Minihan insists. "They have to look for partnerships to help them leverage their investments."

EVEN A WELL-HEELED behemoth can take advantage of the strategic alliance strategy, Etec officials claim. By turning its in-house e-beam technology over to Etec, IBM will get more bang for its R&D buck because the technology is being driven by a larger and more diverse number of players, as well as by the entrepreneurial spirit of the management team. "Big companies such as IBM and AT&T are finally saying, 'Capital equipment is not my area of expertise,' " Halloran notes. "They can help define a new technology, but then it's better to pass it off to a real equipment company."

Etec's challenges for the future include maintaining close customer alliances, developing more partnerships, and improving productivity. Halloran says he wants to improve the sales per employee from 1991's respectable figure of $100,000 to about $150,000 by next year.

The biggest challenge for Etec's managers will be to continue to generate capital for future research investment and to manage it carefully through partnerships, he says. He doesn't want to have to tap the original investor well again. A public offering is a possibility, although not in the immediate future, he adds. □

have scored handsomely from the patent wars, others worry that the litigious environment could harm the industry as a whole. Few dispute the rights of companies or inventors to profit from their patents through licensing, but critics contend the high cost of litigation, in both time and money, saps the industry's creative energies and slows down the introduction of new products.

San Jose-based Sierra Semiconductor Corp., which is being sued by Brooktree, is building up a patent portfolio of its own to fight back, according to C. Stephen Cordial, vice president and chief financial officer. "It's almost like the SALT talks," he says. "You need a stockpile of weapons before you can sit down and talk about getting rid of them."

MANY COMPANIES HAVE found that patent litigation can be a double-edged sword. Brooktree, which whipped AMD in court not long ago, is now fending off patent-infringement claims by—you guessed it—AMD. TI, meanwhile, is being challenged on a key semiconductor patent—the famous Kilby patent—by Japan's Fujitsu Ltd. TI, which has signed licensing deals with Fujitsu on other patents, says it intends to sue Fujitsu.

Some analysts believe the Fujitsu dispute could encourage other companies to call TI's bluff, thereby clouding TI's chances of collecting future patent profits. That could hurt the company's bottom line. TI reported a loss of $157 million for the second quarter, due largely to a work force reduction, while earning $74 million in royalties.

Despite the potential backlash, nobody wants to be the first to call a truce. "Litigation isn't the best way to do business, but companies have no alternative," says David Lovejoy, a lawyer at San Francisco's Fliesler, Dubb, Meyer & Lovejoy. "Whatever you have, you play it."

Whoever claims the moral high ground, one thing is clear: The patent battles have hiked the cost of doing business and have changed—perhaps forever—the nature of competition in the electronics industry.

Just ask Brooktree CEO James Bixby. After founding the company in 1983, his new chip-based technology became the industry standard for computer graphics. Competitors such as AMD soon jumped in with similar products and prices plummeted. Over one six-month period, Bixby recalls, prices plunged 40%. Since winning an injunction against AMD, the price erosion has slowed.

In May Brooktree sued Sierra Semiconductor, alleging Sierra's computer graphics products infringe upon three Brooktree patents. The litigation was expensive, but Bixby says it was worth it. "Technology is the lifeblood of our company. If we can't protect that, we're in trouble."

Sierra, of course, sees things differently. CFO Cordial says the attack by Brooktree has forced his company to divert engineering time from developing new products to

## U.S. patent wars spark Japanese backlash

THE PATENT WARS started in earnest, according to author George Gilder, when Texas Instruments "exploited its patents by suing everyone in sight." Now some observers fear the strategy will backfire on the entire U.S. electronics industry.

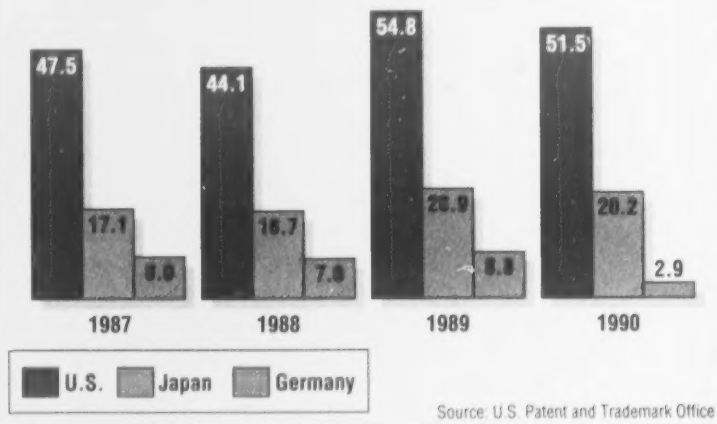
The reason: Japan has reportedly earmarked vast resources to track U.S. patents and beat U.S. companies to the punch. The tactic: Limit the effectiveness of U.S. patents by "bracketing" them with similar Japanese patents, thus forcing U.S. patent-holders to sign licensing deals with the Japanese.

Japan led the pack last year in U.S. patents issued to foreign residents. Hitachi won 40% more U.S. patents than IBM, and the top-four patent winners in this country were Japanese. Some patents, says Gilder, involved "clustering"—protecting a product by patenting unique features rather than the device itself.

Nevertheless, several U.S. patent lawyers say the Japanese knew their way around the U.S. Patent and Trademark Office long before TI launched its patent litigation offensive, and that bracket and cluster patenting are not new. Some argue that mounting global competition would have forced Japan's hand anyway. □

### Japan pumps up its patent portfolio

(thousands of U.S. patents awarded)




Source: U.S. Patent and Trademark Office

# ATE plans for a brighter future—again

## ATE vendors crank out lower-cost products to inject new life into their $2 billion market

By Peter Burrows

This was supposed to be the year the automatic test equipment (ATE) market bounced back. After limping through the late 1980s with annual growth rates of around 5%, analysts expected an upswing in ATE sales to support manufacturers' new generation of hard-to-test components and systems. Systems-on-a-chip would require high-performance VLSI logic testers. Sixteen-megabit DRAMs would require racehorse memory testers. Chips for document imaging and signal processing would require cutting-edge mixed-signal testers. Double-sided, multilayer boards, sometimes populated with multichip modules and other new package types, would require a new, more flexible brand of board tester.

The recession and its hard-to-call recovery have taken much of the air out of that bounce—the $2 billion market should grow just 5.7% in 1991, according to Ken Neff, a market researcher with Prime Data in San Jose. "George Bush is the only one who thinks the recovery is at hand," quips Robert Anderson, CEO and president of GenRad Corp. in Concord, Mass. "With the economy improving so slowly, most customers are content to try to squeeze more out of the equipment they already have."

ATE vendors, by now accustomed to slow growth, have not stood still. Faced with fierce competition and the challenging task of finding ways to test tomorrow's electronic products with today's technology, they have forged ahead with an impressive array of new products. While six of the top 10 ATE vendors suffered decreased sales as recently as 1990, important new products from LTX, Teradyne, Hewlett-Packard, Integrated Measurement Systems, Megatest, Schlumberger, and others should lead to market growth of more than 10% in 1992, predicts Neff of Prime Data. No boom, but better.

The big question is how fast the component test market will grow. Engineering labs are taking delivery of these new testers to help prepare the next-generation devices for market; but while ATE executives had been counting on a banner year in 1992 as these R&D contracts turn into higher-volume production contracts, most have reconsidered and now expect another flat year. Assuming the recovery does pick up steam and a scheduled fab-building spree takes place as planned, component-test equipment sales growth should reach 13%, predicts Neff.

The faltering board-test market is another story. Buffeted by cuts in military spending and falling mar-

### Component test paces ATE growth

Source: Prime Data

gins as a result of slashed spending by weakened computer-makers, the board-test market will increase by less than 5% this year, after three years of declining sales, according to Prime Data. In response, heavyweights like GenRad, HP, and Schlumberger are developing strategies to expand the reach of their products into the huge world of roll-your-own, rack-and-stack test equipment.

The overall sluggish outlook means at least one more gut-wrenching year of high investment and low sales for ATE vendors. Systems routinely cost $20 million to bring to market and may take five years to be fully accepted, so vendors must maintain R&D investments in the range of 15% of revenue to keep up with the incessant pace of new product complexity, which some analysts say rises 35% a year. As a result, the name of the game in ATE is the same since market growth plummeted in the mid-1980s—hold onto market share until the next market boom. "There's not much else we can do," explains GenRad's Anderson. "We could get real aggressive and try to double our market share to improve our volume now, but its not likely we could do that against strong competitors like Teradyne, HP, and Schlumberger."

Walking that tightrope has not been easy. Many companies have bled red ink profusely while waiting for the next market upswing. GenRad, with revenue of $179 million in 1990, lost more than $100 million over the last six years. LTX Corp. in Westwood, Mass., was faced with monstrous cash-flow problems until Japan's Sumitomo Metal Industries Ltd. kicked in $12 million for about 13% of LTX's equity and $12 million for a 49.5% stake in LTX's Japanese operation in 1990. Armed with the cash infusion, LTX finished the development of high-end mixed-signal and VLSI testers and managed to increase its sales by 34% and its market share by more than two percentage points in 1990—the industry's best performance of the year.

# The changing shape of board-test vendors

AFTER THREE YEARS of declining sales and only a modest uptick in sight for this year, it's clear that selling board-test systems as they now exist is not a growth business. This year the market leaders are revealing the shape of things to come.

GenRad, Hewlett-Packard, and Schlumberger Technologies, the top-three vendors of automatic board-test systems, are introducing less costly product lines aimed at the traditional rack-and-stack instrumentation market. Approximately twice as large as the $2 billion automatic test equipment (ATE) market, the rack-and-stack market consists of test engineers who cannot afford, or cannot find, adequate ATE solutions. Instead, they buy nonautomatic instrumentation and measuring devices to integrate into homegrown test systems.

**"With the economy improving so slowly, most customers are content to try to squeeze more out of the equipment they already have," laments Robert Anderson, GenRad's CEO**

"The key to our future is to grow beyond just ATE," says Robert Anderson, president and CEO of GenRad, which has spent over two years and $15 million on new testers despite having lost money in each of the last six years and more than $6 million in the third quarter of this year. "The rack-and-stack folks have always wanted to be replaced—most customers are tired of being in the test and measurement business."

The new-look products from these companies have remarkably similar features. All are heavily software-based and comply with open standards to make them easier to use for the less sophisticated rack-and-stack user. All feature software links that enable test engineers to work more closely with the designers to ensure that new boards are testable from the start. All feature hook-ups with VXIbus instrumentation—single-board-computers that fit into a card-cage and that offer improved performance and efficiency but require little of the cabling of traditional stand-alone instruments that use the VMEbus.

All of these systems are also based on common core architectures. That lets customers use more than one product type in tandem and cuts the vendor's development costs as well. GenRad, for example, recently announced a product for the communications marketplace that will be the core for similar products for the military and other markets once market-specific functionality has been developed.

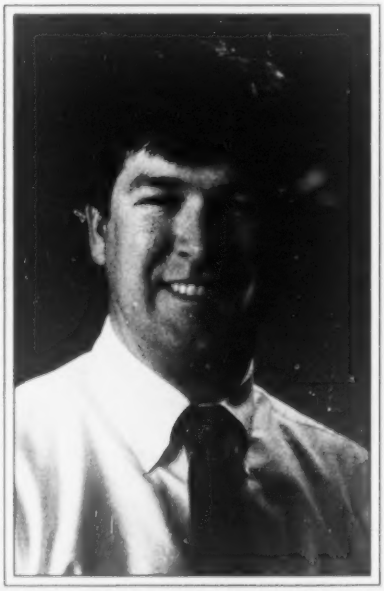
The business formulas behind these new products are also in flux. Vendors are unbundling software and hardware into products rather than shooting for the higher margins of turnkey systems. Service and consulting will become a bigger source of revenue as engineers look for help in testing new boards that feature extensive surface mount technology, innovative package types, and increased density. Schlumberger expects its systems integration business to rise as it helps customers find application-specific instrumentation necessary to round out its core ATE offering. □

Nevertheless, without outside help—or the resources of a broadline parent like HP or Schlumberger—few ATE companies will be able to keep up, says Alex d'Arbeloff, CEO of Teradyne Inc. in Boston. As capital spending shrinks in response to the tighter competition present in most IC, systems, and military markets, the ATE industry is realizing a tough lesson: Maybe the next boom won't be nearly as strong as those in the past.

"We may not like to admit it, but this industry hasn't been cyclical for five years," says Teradyne VP Jim Prestridge. "It's been flat."

TO RESPOND, most ATE companies have been forced to rethink their cost structure to adapt to the new realities. Even market share leaders have been forced to downsize. Teradyne and GenRad had significant layoffs in 1990 and more recently instituted freezes on management pay raises as well as unscheduled plant shut-downs. GenRad reduced its product line and ordered more layoffs during the past few months due to disappointing sales. GenRad and HP initiated partnerships with software companies to reduce their own software development costs. HP has offered early retirement at both its board-test division in Loveland, Colo., and its component test division in Palo Alto. Credence Systems Corp. in Fremont, Calif., laid off 7% of its work force in September. Megatest, in San Jose, laid off employees and outsourced much of its manufacturing to outside contractors.

That new austerity seems to be working, at least for the short term. Teradyne, which lost $21.3 million in 1990, expects to be profitable this year, claims d'Arbeloff. LTX bounced back from a $17 million loss in 1990, including a one-time charge of $14.4 million, with a $6.1 million profit in fiscal 1991. Privately held Megatest, Credence, and HP continue to stay in the black, but just barely. "We need more volume to get our margins where we want them," says Jim Davis, general manager of semiconductor test equipment marketing for HP. The same goes for all.



**"Most chip makers are at a transition point—we need to move to new test technologies as new parts come along," says Micron Technology's Marvin Strong**

COST-CUTTING ALONE will not return the industry to health, however. For almost a decade, electronics manufacturers have spent less and less on ATE, notes Dan Hutcheson, president of VLSI Research in San Jose, and the trend continues. He estimates that the percentage of capital spending devoted to ATE has shrunk from 12.9% in 1984 to 6.8% in 1990. In fact, many customers are still making due with 10- or 20-year-old technology; Fairchild's Sentry line of logic testers (now owned by Schlumberger) dates back to the late 1960s but remains the single most-used tester in the world, says Hutcheson.

The common reason cited for this tight-fistedness is the exorbitant-sounding prices of the newest generation of ATE. A chip maker will pay up to 80% more for the ATE to test 16-Mbit DRAMs than the price of a tester for a 4-Mbit device. Some electronics executives are getting over their sticker shock, as indicated by the brisk sales of $1 million-plus high-end mixed signal testers by Teradyne and LTX and the continued success of market leader Advantest America Inc. in Lincolnshire, Ill., in selling top-of-the-line logic and memory testers. The reasoning behind the new price acceptance is simple—new test technology is required to both ensure quality and maintain time-to-market as increasingly dense integrated ICs and boards come to market.

Marvin Strong is typical of the buyers resigned to their fate of having to pay more for test equipment. Strong, Micron Technology Inc.'s test manager, recognizes that the Boise, Idaho, company will have to pay a higher price for next-generation memory testers able to test 64 devices in parallel and in less time per device than its current tester, which is optimized to test 16 1-Mbit DRAMs concurrently. "Most chip makers are at a transition point, and we're no different," he says. "We recognize the need to move to new test technologies as new parts and packages come along."

But cost-of-test will not fade as an issue—especially as improved manufacturing techniques drive down the number of faults available to be found. "A million dollars doesn't freak people out like it used to, but they're not willing to extrapolate that number out into the future," says Craig Foster, director of marketing for Megatest. "I don't think anyone will ever get $5 million for a tester. After all, chip prices don't rise every year, so why should ATE prices?"

Megatest, a private company that claims to have made money in 17 of its last 19 quarters, may indicate the shape of things to come in ATE. Along with other fast-growing competitors like HP and Credence, Megatest uses technology to drive down the cost of ATE rather than drive up the level of performance. It incorporated extensive IC integration to cut the footprint—and there-

fore the price—of its machines almost in half. HP, which is expected to grow its ATE revenue 25% this year, used technology developed in other HP divisions to reduce its price to well under $1 million for its top-of-the-line model. Credence has used lower-cost CMOS circuitry to reach a similar price point, about $5,000 per test pin, compared with $10,000 or more for testers based on the traditional ECL technology.

All these competitors have, for the most part, avoided cut-throat markets for testing high-volume devices like microprocessors and commodity memories in favor of high-growth ASIC and mixed-signal segments, but their success should not be dismissed as nicely executed nichemanship. The experiences of Jerry Moench, product line manager at Advanced Micro Devices Inc.'s fab in Austin, help explain why.

When his test group suggested the company buy a highly-touted $1 million-plus Advantest logic tester for its programmable logic device products, "management told us to think again," says Moench. His group ended up with a $500,000 Credence tester that has helped reduce test times per device by more than 30%. Although a lack of software has increased the time it takes to write test programs, Moench is content with the choice. "If it takes a bit more engineering resource to get there, we'll do it," he says. "There may be a better solution out there, but we have to worry about the economics, too."

THE CONCERN over the cost of test has also spurred the growth of the test-station market. Pioneered by HP and IMS, these machines were originally designed as front-end tools to help ASIC designers ensure that their designs made sense. Due to their low cost, easy programmability, and flexibility, however, many are now being sold into low-volume production environments and into other traditional ATE applications such as IC characterization and failure analysis. "We want to deliver 90% of ATE's capability for five to 10 times less money," says IMS president Keith Barnes. With less than half the throughput of traditional ATE and with far less functionality, there are big questions as to how far this strategy will take test stations, but Prime Data's Neff and Andrew Rappaport of Boston-based Technology Research Group both predict the $60 million-or-so test-station market could grow beyond $400 million by 1994.

Try as they might to maintain their high-margin products, old-guard ATE players are also finding success in lowering the cost to customers. Analysts credit LTX's comeback on its products' highly modular architecture, which lets customers start small. Market-specific configurations have also proliferated; Teradyne, traditionally weak in VLSI logic testing, made big waves in that market in 1990 with its J971 model. A leap ahead in technology, the machine offers full functionality at a price-per-pin cost of only $7,000—down from about $10,000-plus for the higher throughput of the J953 that preceded it. "If you do the math, the J953 can do more parts, but there's still the sticker price shock factor," says vice president George d'Arbeloff, Alex's younger brother. "Life is just too short to try to educate the world [on the value of high-throughput testers] and maintain performance." While they have no current plans to enter the market, Teradyne executives even admit to watching to see how the low-end test station market shapes up.

"The market seems to agree that we offer our customers extra performance," Alex d'Arbeloff told security analysts last October, "but the market is also becoming resistant to the idea of paying for that performance—which really has been our game over the years. We are now going to have to become the low-cost producer as well as the performance leader." Teradyne is not there yet—and it is not alone. □